



Title: Rent Seeking with Asymmetric Players: An Application to Litigation Expenditures

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Source: European Journal of Legal Studies, Volume 6, Issue 2 (Autumn/Winter 2013/14), p 157-173

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**Abstract:**

*This paper uses insights from the literature on rent-seeking contests to analyze the expenditure decisions of a Defendant and a Plaintiff in the course of their legal battle. It is shown that the total amount of litigation expenditures is affected by the sequence of moves (protocols of interaction), differences in stakes, and the effectiveness of the parties (or the strength of their cases) and information asymmetries. In particular, it is shown that allowing for different stakes many of the results in the rent-seeking literature may not hold.*

**RENT SEEKING WITH ASYMMETRIC PLAYERS: AN APPLICATION TO LITIGATION  
EXPENDITURES**

Svetoslav Salkin \*

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## 1. INTRODUCTION

In this paper I present a simple model that can serve as a framework for analyzing litigants' outlay decisions in the process of their legal battle. The legal battle is modelled as a rent-seeking contest in which players expend resources in order to increase their probabilities of winning a 'prize'. Thus the paper tries to connect, and heavily borrows from, two fields of research: the economics of litigation and the theory of contests (initially considering rent-seeking contests only).

A traditional question within the economics of litigation is: What affects the decision of participants in a legal dispute to go to court instead of settling out?<sup>1</sup> The theory of rent seeking, on the other hand, tries to determine the relationship between the various characteristics of the contest situation and the outlay decisions of the parties involved.<sup>2</sup> In this paper I analyse these outlay decisions taken by litigants once they have decided to go to court. There is a small number of papers that address this specific question, most notably Katz<sup>3</sup>, Hirshleifer,<sup>4</sup> Farmer and Pecorino,<sup>5</sup> and Kahan and Tuckman,<sup>6</sup> among others. As Katz argues the legal battle itself is analytically prior to the decision whether to settle or not because this latter decision is affected by the expectations of the players with respect to their future legal expenditures. Several papers analyze related questions strictly within the context of rent-seeking contests. Risse analyses the total volume of rent-seeking expenditures for one-stage and two-stage rent-seeking contests involving players with negatively interdependent preferences, and concludes that rent dissipation is larger for one-stage contests.<sup>7</sup> Yates presents a particularly interesting formulation in which the winner in a rent-seeking contest is selected probabilistically and pays her bid, while the other contestant pays nothing.<sup>8</sup> He also studies how private information regarding the contest's stakes affects the equilibrium outcome. Contests in which only the winner pays her bid, however, do not model any meaningful kind of litigation contest. Chowdhury and Sheremeta use a general rent-seeking contest formulation similar to the one presented in this paper to show that minor changes in the parameters of the contest success function could result in rather substantial differences in rent dissipation.<sup>9</sup> The results obtained in this paper are therefore special cases of the more general conclusions of Chowdhury and Sheremeta.

The model in this paper analyses how litigation expenditures are affected by differences in terms of stakes and effectiveness of the litigants (or merit of their cases), as well as by informational asymmetries regarding the stakes. Linster<sup>10</sup> presents a rent-seeking model in

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<sup>1</sup> See Thomas J Miceli, *Economics of the Law: Torts, Contracts, Property, Litigation* (OUP 1997).

<sup>2</sup> For a selective survey see Shumel Nitzan, 'Modelling Rent-Seeking Contests' (1994) 10 Eur J of Political Economy 41-60.

<sup>3</sup> Avery Katz, 'Judicial Decisionmaking and Litigation Expenditure' (1988) 8 Intl Rev of L and Economics 127-143.

<sup>4</sup> Jack Hirshleifer, *The Dark Side of the Force: Economic Foundations of Conflict Theory* (CUP 2001).

<sup>5</sup> Amy Farmer and Paul Pecorino, 'Legal Expenditures as a Rent-Seeking Game' (1999) 100 Public Choice 271-88.

<sup>6</sup> Marcel Kahan and Bruce Tuckman, 'Special Levies on Punitive Damages: Decoupling, Agency Problems and Litigation Problems' (1995) 15 Intl Rev of L and Economics 175-88.

<sup>7</sup> Sina Risse, 'Two-Stage Group Rent-Seeking with Negatively Interdependent Preferences' (2011) 147 Public Choice 259-276.

<sup>8</sup> Andrew J Yates, 'Winner-Pay Contests' (2011) 147 Public Choice 93-106.

<sup>9</sup> Subhasish Chowdhury and Roman Sheremeta, 'A Generalized Tullock Contest' (2011) 147 Public Choice 413-420.

<sup>10</sup> Bruce G Linster, 'Stackelberg Rent Seeking' (1993) 77 Public Choice 307-21.

which players attach different values to the ‘prize’ they seek to win, while Kohli<sup>11</sup> and Dixit<sup>12</sup> study how differences in effectiveness affect rent-seeking outlays. Specifically, Kohli and Dixit show that the more ‘effective’ player commits to higher level rent-seeking outlays. The model in this paper shows that this result is crucially dependent on the assumption of equal stakes. Once this assumption is relaxed, as in Linster’s model, Kohli’s result, which he calls the Underdog Theorem, ceases to hold. With regard to asymmetric information, Fu<sup>13</sup> showed that informational asymmetries regarding the value of the ‘prize’ are welfare enhancing in the context of sequential rent-seeking protocols, as they suppress the expenditures of the informed contestant. Section 3.3 of this paper shows that Fu’s result is valid even when litigants differ in terms of effectiveness.

The next section presents the general setting and relates it to the literature. Section 3 specializes the model, motivates its assumptions, derives the equilibrium expenditures under the so called American rule for allocation of litigation costs for two protocols of interaction, Cournot-Nash and Stackelberg, and analyzes the effects of informational asymmetries. Section 4 summarizes the results and concludes the paper.

## 2. LITIGATION AS A RENT-SEEKING CONTEST

The simple world I envisage consists of a Plaintiff and a Defendant who are risk-neutral and have decided to go to trial. The economics of litigation literature explains the fact that people sue each other by referring to differences in perceptions regarding the outcome of the trial, ie each litigant is overly optimistic about her chances of winning.<sup>14</sup> Failure to settle, however, might be also due to attitudes towards risk or simply to malevolence.<sup>15</sup>

Once at trial, the parties decide on their litigation expenditures (or legal efforts). The literature offers different interpretations here. Katz speaks about search of supporting arguments or favourable facts to be presented to a court, jury or administrative agency.<sup>16</sup> Hirshleifer adopts a more general interpretation which may include costs of lawyers, resources devoted to factual investigation and legal research, and bribery.<sup>17</sup> The litigation expenditures affect the probabilities of winning. Note that I am ignoring the Principal-Agent problems that exist between the litigants and their attorneys. It is not impossible, however, to extend the analysis along these lines following Baik and Kim<sup>18</sup> and Schoonebeek.<sup>19</sup>

I will use the following notation:

- $V_p$  - the stakes for the Plaintiff
- $V_d$  - the stakes for the Defendant
- $x_p$  - legal expenditures of Plaintiff
- $x_d$  - legal expenditure of Defendant

<sup>11</sup> Inderjit Kohli, ‘Institutional Structure, Strategic Behavior and Rent-Seeking Costs’ [1994] Working Paper 279, University of California Santa Cruz, Department of Economics.

<sup>12</sup> Avinash Dixit, ‘Strategic Behavior in Contests’ (1987) 77 *American Economic Review* 891-98.

<sup>13</sup> Qiang Fu, ‘Endogenous Timing of Contests with Asymmetric Information’ (2006) 129 *Public Choice* 1-23.

<sup>14</sup> Miceli (n 1).

<sup>15</sup> Hirshleifer (n 4).

<sup>16</sup> *ibid.*

<sup>17</sup> *ibid.*

<sup>18</sup> Kyung Hwan Baik and In-Gyu Kim, ‘Delegation in Contests’ (1997) 13 *Eur J of Political Economy* 281-98.

<sup>19</sup> Lambert Schoonebeek, ‘A Delegated Agent in a Winner-Takes-All Contest’ (2002) 9 *Applied Economics Letters* 21-23.

$\pi_p$  – payoff to Plaintiff  
 $\pi_d$  – payoff to Defendant  
 $P_p$  – probability that Plaintiff wins  
 $P_d$  – probability that Defendant wins

Following the standard setting of the theory of contests, the objective functions of the players are formalized as follows:

The Plaintiff chooses  $x_p$  so as to maximize

$$(1) \quad \pi_p = P_p(x_p, x_d)V_p - x_p$$

Similarly, the Defendant chooses  $x_d$  so as to maximize

$$(2) \quad \pi_d = P_d(x_p, x_d)V_d - x_d$$

The important parts of these expressions are the probabilities of winning  $P_p$  and  $P_d$ . Hirshleifer calls them ‘contest success functions’.<sup>20</sup> The usual assumptions are that each player’s probability of winning is increasing in her own expenditures and decreasing in the expenditures of her opponent, and that they sum up to one. Tullock’s seminal paper offers the classical formulation, which for two players looks as follows:

$$(3) \quad P_i(x_p, x_d) = \frac{x_i^\gamma}{x_p^\gamma + x_d^\gamma}, \quad i=p,d,$$

where  $\gamma$  is a measure of the relative decisiveness of contest efforts. The intuition behind this game is the following:

...we assume two parties who are participating in a lottery under somewhat unusual rules. Each is permitted to buy as many lottery tickets as he wishes at one dollar each, the lottery tickets are put in a drum, one is pulled out, and whoever owns that ticket wins the prize.<sup>21</sup>

Hirshleifer offers two canonical formulations of contest success functions, one in which the relative success depends on the ratios of the respective expenditures (essentially Tullock’s formula), and another in which success depends on the difference between the expenditures.<sup>22</sup>

In the context of litigation expenditures expressions (1) and (2) can be extended in order to analyze the effect of different cost-allocation rules. Shavell<sup>23</sup> discusses four possible systems:

(i) Under the American system where each party bears her own costs the objective functions are as above.

<sup>20</sup> Jack Hirshleifer, ‘Conflict and Rent-Seeking Success Functions: Ratio vs. Difference Models of Relative Success’ (1989) 63 Public Choice 101-12.

<sup>21</sup> Gordon Tullock, ‘Efficient Rent-Seeking’ in James M Buchanan, Robert D Tollison and Gordon Tullock *Toward a Theory of the Rent Seeking Society* (A&M Press 1980) 97-112.

<sup>22</sup> The difference formulation, however, is not very convenient as it often requires numerical solutions.

<sup>23</sup> Steven Shavell, ‘Suit Settlement and Trial: A Theoretical Analysis Under Alternative Methods for the Allocation of Legal Costs’ (1982) 11 J of L Studies 55-82.

(ii) Under the British system the losing party bears all the costs. The objective functions are as follows

$$\pi_i = P_i(x_p, x_d)(V_i + x_p + x_d) - x_p - x_d, \quad i = p, d$$

(iii) Under the system favoring the Defendant, each party bears her own costs if the Plaintiff wins, but the Plaintiff bears all the costs if the Defendant wins. The objective functions are

$$\pi_p = P_p(x_p, x_d)(V_p + x_d) - x_p - x_d; \quad \pi_d = P_d(x_p, x_d)(V_d + x_d) - x_d$$

(iv) Under the system favoring the Plaintiff, each party bears her own costs if the Defendant wins, but the Defendant bears all the costs if the Plaintiff wins. The objective functions are

$$\pi_p = P_p(x_p, x_d)(V_p + x_p) - x_p; \quad \pi_d = P_d(x_p, x_d)(V_d + x_p) - x_p - x_d$$

Other extensions are also possible. Miceli discusses the so-called ‘Rule 68 of the Federal Rules of Civil Procedure’ according to which a Plaintiff who refuses a settlement offer pays the Defendant’s post-offer legal costs if the Plaintiff receives a judgement at trial less than the rejected offer.<sup>24</sup> Daughety and Reinganum<sup>25</sup> consider ‘split-award’ statutes which allocate a portion of punitive damages awards won by successful plaintiffs to the state.

### 3. A SPECIALIZED MODEL

In order to derive analytical solutions, I select a particularly simple variant of contest success function, which nevertheless allows for obtaining non-trivial results. The model in this section combines and extends the rent-seeking models of Linster<sup>26</sup> and Kohli.<sup>27</sup> Both of these papers keep the spirit of the Tullock’s rent-seeking model, but modify some of his details. In particular, Linster analyzed a game where the players attach different values to the rent they compete for, while Kohli analyzed the case where the players differ in their effectiveness. Here I allow for both, ie the players differ both in their valuations of the stakes ( $V_p \neq V_d$ ) and in their effectiveness.

Differences in stakes are particularly relevant in litigation since this is an empirically confirmed fact. From a sample of federal civil cases from the Southern District of New York (SDNY), filed between 1984 and 1987 and terminated by the end of 1998, Waldfogel<sup>28</sup> infers that the highest stake asymmetry pertains to intellectual property cases. The estimates indicate that Plaintiffs stand to gain 33.6 percent more than Defendants stand to lose. Second are contract cases, whereby Plaintiff’s stakes are again higher. The lowest stake asymmetry estimate (but still statistically significant) pertains to torts, whereby

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<sup>24</sup> *ibid*, 170-171.

<sup>25</sup> Andrew F Daughety and Jennifer F Reinganum, ‘Found Money? Split-Award Statutes and Settlement of Punitive Damages Cases’ (2003) 5 *American L and Economics Rev* 134-64.

<sup>26</sup> Linster (n 10).

<sup>27</sup> Kohli (n 11)

<sup>28</sup> Joel Waldfogel, ‘The Selection Hypothesis and the Relationship between Trial and Plaintiff Victory’ (1995) 103 *J of Political Economy* 229-60.

Defendant's stakes are higher.<sup>29</sup> A possible explanation is that when a tort Defendant loses she is often exposed to potential liability from additional Plaintiffs. Similarly, a losing intellectual property Plaintiff is more likely to become subject of additional encroachments.<sup>30</sup>

The assumption of differences in effectiveness, on the other hand, is difficult to evaluate empirically, but actually has strong intuitive appeal. Hirshleifer and Osborne<sup>31</sup> speak of one side or the other being more adept in converting legal effort into desirable outcome. Note, however, that a 'differences in effectiveness' parameter can represent differences in the true strength of the cases of the sides (ie one of the litigants having a more meritorious case) or the true degree of Defendant's fault. In what follows I will speak of one side being more effective than the other (although the true degree of Defendant's fault might be more appropriate).

A prominent example of the double asymmetry discussed in this paper is a lawsuit filed by Russian oligarch Boris Berezovsky against his former business partner, Roman Abramovich, in the UK in 2011-2012.<sup>32</sup> Both businessmen were very close to former Russian President Boris Yeltsin in the 1990s, and used their political influence to amass huge fortunes through the Russian government's controversial loans-for-shares privatization programme. Whereas Roman Abramovich remained close to the Kremlin during the terms of President Putin, who succeeded Boris Yeltsin, and President Medvedev, Boris Berezovsky has been forced to flee to the UK in 2000 and was later convicted in absentia over alleged embezzlement and related crimes in Russia.

In 2011, Boris Berezovsky launched what turned out to be one of the most expensive lawsuits in the history of the UK against Roman Abramovich. The litigation expenditures associated with the four-month legal battle exceeded £100 million.<sup>33</sup> Boris Berezovsky claimed that Roman Abramovich had used 'threats' and 'intimidation' to make him and Georgian-born businessman Badri *Patarkatsishvili sell their stakes in oil firm Sibneft and aluminum producer RusAl at excessively low prices. All in all*, Boris Berezovsky sought over \$5 billion in compensation for the 'coerced' sale of his stake in Sibneft, and over \$564 million in compensation for the 'coerced' sale of his stake in RusAl.<sup>34</sup>

Roman Abramovich, however, denied that Boris Berezovsky and Badri Patarkatsishvili owned any stakes in Sibneft and RusAl, and alleged that he had paid a total of \$2.3 billion to Boris Berezovsky in exchange for 'political protection'. Indeed, Boris Berezovsky failed to present any documents proving his claims. He insisted instead that all agreements regarding ownership in the two firms had been made orally. The court dismissed all claims

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<sup>29</sup> Waldfogel's study is much richer than that. In particular, he finds strong support for the so-called selection hypothesis according to which the sample of tried cases is unrepresentative of the population of underlying disputes (see also Miceli (n 1) 138)

<sup>30</sup> *ibid*, 253.

<sup>31</sup> Jack Hirshleifer and Evan W Osborne, 'Truth, Effort, and the Legal Battle' (2001) 108 *Public Choice* 169-195.

<sup>32</sup> Jane Croft, 'Abramovich Case Awaits Ruling' *Financial Times* (London, 28 August 2012) <<http://www.ft.com/cms/s/0/fca2aa3a-f124-11e1-b7b9-00144feabdc0.html#axzz2SatyOLoD>> accessed 3 May 2013.

<sup>33</sup> Jane Croft and Neil Buckley, 'Berezovsky Loses against Abramovich' *Financial Times* (London 31 August 2012) <<http://www.ft.com/intl/cms/s/0/8eec8602-f34d-11e1-9c6c-00144feabdc0.html#axzz2SKTwRxp3>> accessed 3 May 2013.

<sup>34</sup> Executive Summary of the Full Judgement of Gloster J in *Berezovsky v Abramovich*, Action 2007 Folio 942 <<http://www.judiciary.gov.uk/Resources/JCO/Documents/Judgments/berezovsky-abramovich-summary.pdf>> accessed 13 May 2013.



made by Boris Berezovsky. He was described by Judge Elisabeth Gloster as ‘an unimpressive, and inherently unreliable, witness, who regarded truth as a transitory, flexible concept, which could be moulded to suit his current purposes’. Some of the evidence he gave was described as ‘deliberately dishonest’. Roman Abramovich’s answers, on the other hand, were considered ‘careful and thoughtful’. He was furthermore described as a ‘truthful, and on the whole reliable witness’ and ‘frank in making concessions where they were due’.<sup>35</sup>

The lawsuit was obviously a desperate move by Boris Berezovsky, who had allegedly lost most of his wealth by the time of the trial. At the same time, Roman Abramovich, with an estimated net worth of around \$11.2 billion, was still one of the richest and most influential Russian oligarchs.<sup>36</sup> Therefore, the marginal utility of the \$5.564 billion sought by Boris Berezovsky was clearly much larger for Boris Berezovsky himself than it was for Roman Abramovich. Regarding the relative merits of the claims of the litigants, it must have been patently clear to both of them that given the lack of any written evidence or witnesses other than Boris Berezovsky, all Roman Abramovich had to do to win the case was deny anything that Boris Berezovsky claimed.

With the above remarks and example in mind, the contest success functions I will use are the following

$$P_p(x_p, x_d) = \frac{ax_p}{ax_p + x_d}; \quad P_d(x_p, x_d) = \frac{x_d}{ax_p + x_d}$$

here  $a$  denotes the relative effectiveness of the Plaintiff. The Plaintiff is more effective when  $a > 1$ .<sup>37</sup>

The major disadvantage of such a simple formulation is that it cannot be meaningfully applied to all four cost allocation systems outlined in the previous section. Except for the American system, it turns out that in equilibrium one of the players spends an infinite amount of resources in the legal conflict.<sup>38</sup> More complicated formulations avoid this problem, the disadvantage, however, is that the analysis should proceed by calculating numerical solutions (this is actually a problem in many rent-seeking models). The present formulation, however, nicely fits the American rule, thus I consider this system only leaving the other three for further investigation.

Under the American system the objective functions of the Plaintiff and the Defendant respectively are

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<sup>35</sup> *ibid.*

<sup>36</sup> Forbes (New York, 10 October 2010) <[http://www.forbes.com/lists/2010/10/billionaires-2010\\_Roman-Abramovich\\_DG3G.html](http://www.forbes.com/lists/2010/10/billionaires-2010_Roman-Abramovich_DG3G.html)> accessed 5 May 2013.

<sup>37</sup> If the effectiveness of the players are measured by  $e_i$ ,  $i=p,d$ , the contest success functions become

$\frac{e_i x_i}{e_p x_p + e_d x_d}$ . The above expressions are derived by setting  $a = \frac{e_p}{e_d}$ .

<sup>38</sup> To prove that this is the case for the British system, note that differentiating the Plaintiff’s objective function and setting it equal yields  $V_p + x_p(1-a)$ , which is positive and is independent of  $x_d$ . The same holds for the Defendant’s objective function.



$$(4) \quad \pi_p = \frac{ax_p}{ax_p + x_d} V_p - x_p, \text{ and}$$

$$(5) \quad \pi_d = \frac{x_d}{ax_p + x_d} V_d - x_d.$$

I examine two protocols or interaction, Cournot-Nash, ie when the players move simultaneously or in ignorance of each other's moves and Stackelberg, when the players move sequentially. I assume that it is the Plaintiff who moves first and commits to a level of expenditures. Hirshleifer and Osborne also consider what they call a 'threat-and promise' protocol in which the Defendant makes the prior commitment. The objective functions considered in this paper however are symmetric, which makes such an extension unnecessary.

### 3.1. Cournot-Nash Protocol of Interaction

The Cournot-Nash setting represents a standard simultaneous move game. Differentiating the objective functions and setting them equal to zero gives the following reaction functions

$$(6) \quad x_p(x_d) = \frac{\sqrt{aV_p x_d} - x_d}{a}$$

$$(7) \quad x_d(x_p) = \sqrt{aV_d x_p} - ax_p$$

At Nash equilibrium the expenditures of the players are

$$(8) \quad x_p^c = \frac{aV_d V_p^2}{(aV_p + V_d)^2}$$

$$(9) \quad x_d^c = \frac{aV_p V_d^2}{(aV_p + V_d)^2}$$

Thus the total amount of litigation expenditures in equilibrium, ie  $C^c = x_p^* + x_d^*$  is

$$(10) \quad C^c = \frac{aV_d V_p (V_p + V_d)}{(aV_p + V_d)^2},$$

where the superscripts  $c$  stands for Cournot-Nash.

Kohli<sup>39</sup> shows that the total level of expenditures (in his terminology, rent-seeking costs) is maximized when the players are equally effective, ie when  $a=1$ . The result holds, however, only if the players attach the same value to the rent they are competing for (have the same stakes), ie whenever  $V_p=V_d$ . To find the maximization point under the current setting, I differentiate (10) with respect to  $a$  and set it equal to zero.

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<sup>39</sup> Kohli (n 11).

$$(11) \quad \frac{\partial C^c}{\partial a} = \frac{V_d V_p (V_p + V_d)(V_d - a V_p)}{(a V_p + V_d)^3}$$

This is equal to zero at  $a = \frac{V_d}{V_p}$ . In other words, in the Cournot-Nash setting the litigation expenditures are maximized when the relative effectiveness of the players equals the ratio of their stakes.

It is also interesting to find the equilibrium payoffs of the players derived by Linster<sup>40</sup> for equally effective players, and show that they differ when asymmetric effectiveness is introduced. The expressions are the following

$$(12) \quad \pi_p^c(x_p^c, x_d^c) = \frac{a V_p^2}{a V_p + V_d} \left( 1 - \frac{V_d}{a V_p + V_d} \right), \text{ for the Plaintiff, and}$$

$$(13) \quad \pi_d^c(x_p^c, x_d^c) = \frac{V_d^2}{a V_p + V_d} \left( 1 - \frac{V_d}{a V_p + V_d} \right), \text{ for the Defendant.}$$

When the players have equal effectiveness,  $a$  is equal to 1 and I obtain Linster's result

$$\pi_i^c(x_p^c, x_d^c) = \frac{V_i^2}{(V_p + V_d)^2}, \text{ for } i=p,d.$$

### 3.2. Stackelberg Protocol of Interaction

In this setting the players move in sequence. Dixit<sup>41</sup> analyzes a more general model than the present one and identifies a very interesting result: If pre-commitment to effort level (in my case litigation expenditures) is allowed, then the 'favorite' in the contest will commit herself to a higher level of effort than would have been the case if commitment was not allowed, and the 'underdog' will commit herself to a lower level. Hirshleifer and Osborne reach the same conclusion.<sup>42</sup> Kohli obtains a similar result independently and calls it the 'Underdog Theorem'. The interesting implication for the present analysis is that the total litigation expenditures under Stackelberg differ from Cournot-Nash. The present section enriches Kohli's formulation by allowing for different stakes.

I assume that the Plaintiff moves first. The game is solved along the lines of backwards induction, ie what I derive is the sub-game perfect equilibrium of the game. Knowing the best response function of the Defendant (expression (7)), the Plaintiff's objective function becomes

$$(14) \quad \pi_p(x_p, x_d(x_p)) = V_p \sqrt{\frac{a x_p}{V_d}} - x_p$$

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<sup>40</sup> Linster (n 10).

<sup>41</sup> Dixit (n 12).

<sup>42</sup> *ibid*, 160.

This is maximized at

$$(15) \quad x_p^s = \frac{aV_p^2}{4V_d}$$

The Defendant's response is

$$(16) \quad x_d^s = \frac{aV_p}{2} \left( \frac{2V_d - aV_p}{2V_d} \right), \text{ which is positive for } a < 2V_d/V_p. \text{ For}$$

$a \geq 2V_d/V_p$ , however, the Defendant spends zero in equilibrium and the Plaintiff spends  $V_d/a$ .

It is straightforward now to present Dixit's over-commitment result for equal stakes. If  $1 < a < 2$  (ie the effectiveness of the Plaintiff is higher) the Plaintiff's equilibrium expenditures in the Stackelberg protocol are greater than the respective expenditures in the Cournot-Nash setting. The result is obtained after examining the inequality  $x_p^c < x_p^s$ . Substituting the respective expressions from (8) and (15) and setting  $V_d = V_p$  this inequality boils down to  $a > 1$ , which is true by assumption. As Hirshleifer and Osborne put it "merit and effort are complements".<sup>43</sup> Of course, with asymmetric stakes the result holds only if  $a > V_d/V_p$ , ie when the relative effectiveness parameter is larger than the ratio of the stakes.

I further examine the total expenditures in the Stackelberg scenario for  $a < 2V_d/V_p$ , by summing  $x_p^s$  and  $x_d^s$ . This results in

$$(17) \quad C^s = \frac{aV_p}{2} \left( \frac{V_p(1-a)}{2V_d} + 1 \right), \text{ which is maximized at}$$

$$(18) \quad a = \left( \frac{1}{2} + \frac{V_d}{V_p} \right).$$

If the stakes are equal, the result coincides with the one obtained by Kohli (Proposition 2) - total outlays in the Stackelberg setting are maximized when the Plaintiff's effectiveness is greater, ie at  $a=3/2$ . The present formulation shows that this need not be the case with asymmetric stakes. If  $2V_d < V_p$ , ie the stakes of the Defendant are sufficiently smaller than those of the Plaintiff, the litigation expenditures reach their maximum at a point where the Defendant is more effective,  $a < 1$ . This result is perhaps best explained by the fact that stake asymmetries change the relative marginal benefits of litigation expenditures. In other words, if the stake of the Plaintiff is sufficiently larger than the stake of the Defendant, then the Plaintiff's marginal benefits from an extra unit of expenditures on litigation is too small, and therefore not worth making, if the Plaintiff's effectiveness, or the merit of her case, is sufficiently smaller than the Defendant's effectiveness, of the merit of her case.

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<sup>43</sup> *ibid*, 161.

Let us see now the net payoffs of the players in the Stackelberg scenario. For the Plaintiff, the net payoff is

$$(19) \quad \pi_p^s(x_p^s, x_d^s) = \frac{aV_p^2}{4V_d}, \text{ for } a < 2V_d/V_p, \text{ and}$$

$$(20) \quad \pi_p^s(x_p^s, x_d^s) = \frac{aV_p^2 - V_d}{a}, \text{ for } a \geq 2V_d/V_p.$$

The net payoffs for the Defendant respectively are

$$(21) \quad \pi_d^s(x_p^s, x_d^s) = V_d + aV_p \left( \frac{aV_p}{4V_d} - 1 \right), \text{ for } a < 2V_d/V_p, \text{ and}$$

$$(22) \quad \pi_d^s(x_p^s, x_d^s) = 0, \text{ for } a \geq 2V_d/V_p.$$

Now it is possible to compare the net payoff of the Plaintiff in the Stackelberg setting with the respective payoff under the Cournot-Nash protocol for  $a < 2V_d/V_p$ . The interesting result to note is that the net payoff of the Plaintiff is always better in the Stackelberg protocol than on the Cournot-Nash protocol. This becomes evident when examining the following inequality

$$\pi_p^s(x_p^s, x_d^s) \geq \pi_p^c(x_p^c, x_d^c).$$

After substituting with the respective expressions from (19) and (12) and rearranging this expression reduces to  $0 \leq (aV_p - V_d)^2$ , which is obviously true. Under the present formulation, however, similar comparisons with respect to the Defendant yield ambiguous results.

Next, for the sake of completeness, I compare the amount of total litigation expenditures under the two protocols of interaction. First, by examining expressions (10) and (17) it is easy to check that total outlays are equal under Cournot-Nash and under Stackelberg if the players are equally effective and have equal stakes ( $a=1$ ,  $V_p=V_d$ ). Similarly, in this case, their net payoffs are the same (by checking expressions (12), (13), and (19) through (22)). Second, with equal stakes, but not necessarily equal effectiveness this no longer holds. For  $V_p=V_d=V$  and  $a < 2$ , subtracting  $C^s$  from  $C^c$  results in

$$(23) \quad C^c - C^s = \frac{aV}{(a+1)^2} (5 + a^2)(1 - a).$$

This is positive for  $a < 1$ , zero for  $a = 0$ , and negative for  $a > 1$ .

For  $a > 2$ , the expenditures of the Defendant in the Stackelberg protocol are zero, and the total amount of expenditures is simply  $V/a$ . Thus

$$(24) \quad C^c - C^s = \frac{V}{a(1+a)^2} (a^2 - 2a - 1).$$

This is negative for  $2 < a < 1 + \sqrt{2}$ , and non-negative for  $a \geq 1 + \sqrt{2}$ .

What is the intuition behind these results? The litigation expenditures are lower in the Stackelberg protocol than in Cournot-Nash for  $a < 1$ . The Defendant spends less because she is strategically disadvantaged, while the Plaintiff spends less because she is less effective. If  $1 < a < 1 + \sqrt{2}$ , the expenditures are higher in the Stackelberg protocol because the leader spends more to take advantage of her increased effectiveness. For even larger values the Plaintiff is much more effective, the defendant spends zero and the total level of expenditures is again lower.

It can be also shown that for  $a < 1$  the net payoff of the Defendant is lower under Stackelberg than under Cournot-Nash. Having in mind that this is true for the Plaintiff for any  $a$ , Kohli's claim (recast in the terminology of this paper) is that if the Plaintiff is less effective, the Stackelberg equilibrium is more efficient than the corresponding Cournot-Nash, ie leads to a lower level of expenditures and higher payoffs for the litigants.

Finally, it is possible to compare the litigation expenditures when the players are equally effective,  $a=1$ , but the stakes are different

$$(25) \quad C^c - C^s = \frac{V_p}{2(V_p + V_d)} (V_d - V_p)$$

This is positive for  $V_d > V_p$ , negative for  $V_d < V_p$ , and zero for equal stakes. In words, with equal effectiveness the total level of expenditures is greater in the Cournot-Nash case if the Defendant has larger stake, otherwise the Stackelberg case involves a higher level of expenditures.

### ***3.3. Rent Seeking with Asymmetric Information Regarding the Value of the Prize***

The last extension of the basic litigation model considered in this paper assumes that the two contestants attach the same value to the prize, but one of the contestants has superior information about that value. The most interesting scenario in this setting occurs when the contestants move sequentially, as this would have the informed contestant trying to signal her information to the uninformed contestant.

A prominent example of lawsuits with asymmetric information involves disputes over oil extraction rights. Firms bidding for oil rights typically attach the same value to the 'prize' they bid for. In the terminology of auction theory they have common values Cramton.<sup>44</sup> Once a firm wins the right to search for oil, it quickly updates its estimate for the actual value of the deposit in question. Suppose then that one of the losing bidders takes the winner to court over alleged irregularities during the bidding process. If the winner (or Defendant) is the first one to choose litigation expenditures, then the interaction has the structure of a signaling game.<sup>45</sup>

<sup>44</sup> Peter Cramton, 'How Best to Auction Oil Rights' in Macartan Humphreys, Jeffrey D Sachs, and Joseph E Stiglitz (eds), *Escaping the Resource Curse* (Columbia University Press 2007).

<sup>45</sup> Michael Spence, 'Job Market Signaling' (1973) 87 Q J of Economics 355-374.

Fu,<sup>46</sup> among others, analyzed such an extension and reported the main result obtained in this subsection, namely that the low value informed contestant would like to spend less on rent seeking in order to credibly prove that the prize's value is indeed low. Hence, in the context of dissipative contests (lobbying, corruption and other rent seeking contests), informational asymmetries are welfare enhancing in that they reduce the total amount of rent-seeking expenditures. In the literature on industrial organization Gal-Or<sup>47</sup> studies Cournot's duopoly model when one of the firms is better informed about demand. Tirole<sup>48</sup> provides an especially instructive presentation of Gal-Or's model and the analysis below follows Tirole's exposition. This subsection shows that Fu's result remains valid in the case of differences in effectiveness. In other words, informational asymmetries reduce litigation expenditures even when effectiveness asymmetries are allowed.<sup>49</sup> The remainder of the subsection assumes that the informed contestant moves first in order to send a signal regarding the value of the prize.

Assume that the Defendant and the Plaintiff attach the same value to a prize, but this value can be of two types,  $V_L$  and  $V_H$ , such that  $0 < V_L < V_H$ . The Defendant learns the prize's type, which hereafter will be referred to as the Defendant's type, and chooses her rent seeking expenditures. Thereafter the Plaintiff observes the Defendant's choice, but not her type, and chooses her rent seeking expenditures. This ends the game.

To find the sequential equilibria of this game, denote the Plaintiff's prior beliefs by  $p(V_L) = q$  and  $p(V_H) = 1 - q$ . After observing the Defendant's move, the Plaintiff updates her beliefs as follows  $p^o(V_L | x_i) = \mu(x_i)$  and  $p^o(V_H | x_i) = 1 - \mu(x_i)$  and maximizes her payoff function given these updated beliefs. Symbolically, the Plaintiff maximizes the following expression

$$(26) \quad \{\mu(x_d)V_L + [1 - \mu(x_d)]V_H\} \frac{\alpha x_p}{\alpha x_d + x_p} - x_p$$

Hence her best response function is given by

$$(27) \quad BR(x_d) = x_p(x_d) = \sqrt{\alpha x_d} \left\{ \sqrt{\mu(x_d)V_L + [1 - \mu(x_d)]V_H} - \sqrt{\alpha x_d} \right\}$$

Expression (27) is decreasing in  $\mu(x_d)$ , the belief that the prize is low, therefore, the Defendant will try to convince the Plaintiff that the prize is low in order to make the Plaintiff devote less resources to rent seeking and thereby increase her (the Defendant's) chances of winning.

Using incentive compatibility logic, it is straightforward to show that in any separating equilibrium the Defendant spends more resources on litigation when the prize is high. Denote the optimal choices of the high and the low type by  $x_d^H$  and  $x_d^L$ , respectively. To ensure that these choices satisfy incentive compatibility, it must be the case that neither

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<sup>46</sup> Fu (n 13)

<sup>47</sup> E Gal-Or, 'First Mover Disadvantages with Private Information' (1987) 54 Rev of Economic Studies 279-292.

<sup>48</sup> Jean Tirole, *The Theory of Industrial Organization* (MIT Press 1988) 450-452.

<sup>49</sup> A more complete treatment would include stake asymmetries as well. However, such an extension makes the model technically very difficult and should be treated in a separate paper.

type has an incentive to select the equilibrium choice of the other type. In other words, the following two inequalities should be satisfied

$$(28) \quad V_L \frac{x_d^L}{x_d^L + \alpha BR(x_d^L)} - x_d^L \geq V_L \frac{x_d^H}{x_d^H + \alpha BR(x_d^H)} - x_d^H \text{ (ICL)}$$

$$(29) \quad V_H \frac{x_d^H}{x_d^H + \alpha BR(x_d^H)} - x_d^H \geq V_H \frac{x_d^L}{x_d^L + \alpha BR(x_d^L)} - x_d^L \text{ (ICH)}$$

The first inequality is the low type's incentive compatibility condition and the second inequality is the high type's incentive compatibility condition. Subtracting the right hand side of (ICH) from the left-hand side of (ICL), and subtracting the right-hand side of (ICH) from the from the left-hand side of (ICH) yields

$$(30) \quad (V_H - V_L) \frac{x_d^H}{x_d^H + \alpha BR(x_d^H)} \geq (V_H - V_L) \frac{x_d^L}{x_d^L + \alpha BR(x_d^L)}$$

Since  $V_L < V_H$ , this expression is equivalent to

$$(31) \quad \frac{x_d^H}{x_d^L} \geq \frac{BR(x_d^H)}{BR(x_d^L)}$$

From expression (27) it can be shown that the best response correspondence  $BR(\cdot)$  is an increasing concave function, hence the last inequality is true if and only if  $x_d^H > x_d^L$ , which proves the claim that the high-type Defendant spends more on litigation than the low-type Defendant.

The remaining part of this sub-section identifies the separating equilibria of the game.

### 3.4 Separation

In a *separating* equilibrium the type of the Defendant is revealed. The preceding analysis implies that the high type plays her full information strategy,  $V_H/4, \frac{V_H}{4}$ , and obtains her full equilibrium payoff,  $V_H/4$ . Denote the low type's separating equilibrium strategy by  $x_d^{LS}$ . To simplify notation, set  $L = \sqrt{x_d^{LS}}$ .

To achieve separation, in equilibrium the beliefs of the players should be confirmed. The incentive compatibility constraint for the low type that sustains such an outcome is the following

$$(32) \quad \frac{\sqrt{V_L} - \sqrt{V_H - V_L}}{2} \leq L \leq \frac{\sqrt{V_L} + \sqrt{V_H - V_L}}{2}$$

The incentive compatibility constraint for the high type is given by



$$(33) \quad \frac{V_H - \sqrt{V_H^2 - V_H V_L}}{2\sqrt{V_L}} \leq L \leq \frac{V_H + \sqrt{V_H^2 - V_H V_L}}{2\sqrt{V_L}}$$

Next, if the low type is thought to be a high type and maximizes her payoff function given that belief, she (the low type) would obtain

$$(34) \quad \frac{V_L^2}{4V_H} = \max_{x_d^L} \left\{ V_L \frac{x_d^L}{x_d^L + BR(x_d^H)} - x_d^L \right\}$$

Hence, the following rationality condition should hold

$$(35) \quad L(\sqrt{V_L} - L) \geq \frac{V_L^2}{4V_H}$$

This inequality is satisfied for

$$(36) \quad \sqrt{V_L} - \sqrt{V_L - \frac{V_L^2}{V_H}} \leq 2L \leq \sqrt{V_L} + \sqrt{V_L - \frac{V_L^2}{V_H}}$$

To conclude, the range of separating equilibria is given by

$$(37) \quad \frac{\left( \sqrt{V_L} - \sqrt{V_L - \frac{V_L^2}{V_H}} \right)^2}{4} \leq x_d^{LS} \leq \frac{\left( V_H - \sqrt{V_H^2 - V_L V_H} \right)^2}{4V_L}$$

Typically signalling games exhibit a multiplicity of both pooling and separating equilibria. Most equilibrium refinements developed by game theorists select the least-cost-separating equilibrium, or Riley equilibrium.<sup>50</sup> Following the intuitive criterion proposed by Cho and Kreps,<sup>51</sup> least-cost separation occurs at the upper bound of the interval in expression (37).

$$(38) \quad x_d^{LCS} = \frac{\left( V_H - \sqrt{V_H^2 - V_L V_H} \right)^2}{4V_L}$$

Hence the low type has an incentive to bid below its equilibrium strategy under complete information in order to credibly prove her knowledge. The expression  $x_d^{LCS}$  is increasing in  $V_H$  and is decreasing in  $V_L$ .

#### 4. SUMMARY OF RESULTS AND CONCLUSION

Whether Stackelberg or Cournot-Nash is the appropriate protocol and the extent to which asymmetric information plays a role in the Stackelberg setting is context-specific and depends very much on the information flows between the players. Clearly this is a crucial

<sup>50</sup> John Riley, 'Informational Equilibrium' (1979) 47 *Econometrica* 331-359.

<sup>51</sup> In-Koo Cho and David Kreps, 'Signaling Games and Stable Equilibria' (1987) 102 *Q J of Economics* 179-221.

question when it comes to empirical testing. Nevertheless, the present analysis can be helpful in advancing some propositions. Most of the results below are obtained by others in the literature. Allowing for different stakes, however, leads to a number of modifications.

The results in the paper are as follows:

1. In the Cournot-Nash protocol the level of litigation expenditures is maximized when the relative effectiveness (or the relative merit of the cases) of the parties equals the ratio of their stakes. In the Stackelberg protocol with equal stakes the level of litigation expenditures is maximized when the Plaintiff's effectiveness (merit) is sufficiently greater. With unequal stakes, however, this is no longer true. If the stakes of Defendant are sufficiently smaller, the litigation expenditures reach a maximum at a point where the Defendant is more effective (has stronger case).
2. In the Stackelberg protocol the Plaintiff's expenditures are greater than in Cournot-Nash if her effectiveness (merit) is higher (but not too high,  $1 < a < 2$ ).
3. If the stake of the Plaintiff is sufficiently smaller than the stake of the Defendant, relative to her effectiveness or the merit of her case, the Plaintiff is better off (has higher net payoff) in the Stackelberg protocol than in Cournot-Nash, ie pre-commitment is desirable for the Plaintiff. The situation of the Defendant is ambiguous.
4. With equal stakes, if the Plaintiff is less effective (has less merit), the Stackelberg equilibrium is more efficient than the corresponding Cournot-Nash, ie leads to lower legal expenditures and higher payoffs for the litigants (Kohli's "Underdog theorem"). Again the result may not hold if the stakes are different.
5. With equal effectiveness, the total level of expenditures is greater in the Cournot-Nash protocol if the Defendant has a larger stake, otherwise the Stackelberg protocol involves a higher level of expenditures.
6. Informational asymmetries tend to suppress litigation expenditures regardless of differences in effectiveness or merit, as the informed party has an incentive to signal the low value of the prize to the uninformed party. With asymmetric information total litigation expenditures might be smaller than litigation expenditures in the cases of perfect information or imperfect but symmetric information, ie when both litigants lack information.

A number of extensions are possible. In particular, it is important to examine what happens under the different cost allocation rules outlined in section 2. Furthermore, a more realistic analysis would explicate the role of the decision maker, ie the court or the jury. The analysis of Congelton offers a general framework for addressing this problem.<sup>52</sup> Finally, the principal-agent problems in the relationships between the litigants and their attorneys should be accounted for.

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<sup>52</sup> Roger D Congelton, 'Committees and Rent-Seeking Effort' (1984) 25 J of Public Economics 197-209.